Infiltration and Inflow Plan

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COMMITMENT & INTEGRITY DRIVE RESULTS

217319
Town of Hull, MA
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EXECUTIVE SUMMARY

Infiltration and Inflow (I/I) occurs when uncontrolled water enters a sanitary sewer through deficiencies in the collection system. Infiltration reaches a collection system through faults and broken sewer lines, while inflow enters by illegal sanitary sewer connections and faults in manholes covers. As infrastructure ages, I/I become a more prevalent issue and may pose severe impacts on a wastewater treatment facility. These adverse effects range from sewer backups, basement flooding, damage to existing wastewater infrastructure, and possible increases of operation and maintenance costs associated with the wastewater treatment and pumping facilities.

Numerous studies were conducted to identify, mitigate, and resolve ongoing concerns relating to excessive wastewater flows. Woodard & Curran (Contractor) entered into a service contract for the operation and maintenance of the water pollution control facilities for the Town of Hull. The Contractor began operation of the facility on April 1, 2015. In May 2016, the U.S Environmental Protection Agency (EPA) issued an Administrative Order of Consent (AOC) to the Town of Hull to develop an Infiltration and Inflow Control Plan that will implement a consistent long-term approach for effectively addressing current and future I/I to the WWTF and collection system. The I/I Control Plan includes the following items:

A. Summary of Existing I/I Control Plan

B. Description Sewer Rehabilitation Projects

C. Description of Public & Private Inflow

D. Annual Estimates of I/I

    a. Yearly

    b. Peak

E. Future I/I Control Plan

A. SUMMARY OF EXISTING I/I CONTROL PLAN

DISCUSSION OF PROGRAM UNDER THE NPDES PERMIT

According to Town of Hull's WWTP NPDES Permit No. MA0101231, multiple guidelines are mandated for the Infiltration/Inflow (I/I) Control Plan. The annual I/I control plan must be submitted to the EPA and MassDEP within six months of the effective permit date and reported by March 31st of each year. The reports follow actions taken to reduce I/I during the previous calendar year. Section E.4 of the Permit requires two deliverables: I/I Plan and I/I Report, as summarized in Table 1 below:

Table 1: NPDES Required I/I Annual Deliverables

Plan	Report
Identify and remove sources of I/I	A map and description of inspection and maintenance done along with any corrective actions conducted
Level and sources of funding	Expenditures for any I/I maintenance and corrective actions
Inflow identification and control program of disconnection and redirection of illegal sump pumps and roof down spouts	Map of areas of I/I investigation/actions in the coming year
Identification of areas where increased aquifer recharge is from reduced I/I	Calculation of the annual average I/I and max month I/I for the reporting year
Educational public outreach program	A report of any I/I corrective actions taken as a result of unauthorized discharges reported pursuant to 314 CMR 3.19(20) and reported pursuant to the Part 1, Section D.1 Unauthorized Discharges

Historic I/I Control Plans (from 2009 -2015)

The existing I/I control plans were developed by the previous Chief Facility Manager for the Town of Hull, as well as multiple plant managers through United Water (the previous Contract Operator) and have varied in content throughout the years. The following is an example list of maintenance activities and corrective actions of the Town's sewer collection system that has been performed since 2009:

- Pipe replacements and repairs
- CCTV inspections
- Replacement and repairs of manhole frames and covers
- Manhole rebuilds
- Engineering Services
- Hydrogen sulfide control
- Force main replacements
- Collection system inspections and cleanings

Although information varies across historic I/I Control Plans, the goal was to CCTV 10,000 linear feet of sewer line and clean 20% of the collection system as part of the annual collection system cleaning and inspection program. A subcontractor was used to perform the Town's annual collection system cleaning and inspections. A summary of the existing I/I control plans and annual budgets beginning on September 2009 may be reviewed in Table 2, with detailed information provided in Appendix B.

Table 2: Historic Hull WWTF I/I Control Plan Summary

Year	Annual Average I/I (MGD)	Peak I/I (MGD)	Budget Available for Next Fiscal Year	Capital Budget to Resolve I/I	I/I Study Expenses
2009	0.3	0.5	$64,000.00	$200,000.00	-
2010	0.3	0.5	$71,800.00	$200,000.00	-
2011	0.3	0.5	$71,800.00	$185,000.00	-
2012	-	-	$71,800.00	$185,000.00	-
2013	-	-	$71,800.00	$126,000.00	$21,521.00
2014	-	-	$71,800.00	$125,000.00	$50,148.00
2015	0.02*	1.01*	$63,550.00	$62,000.00	-

*As calculated in Section D of this Control Plan.

B. SEWER REHABILITATION PROJECTS

Since 2005, numerous projects have been undertaken to restore Hull's aging sewer collection system. Below is summary of projects that have been completed since 2005, and cost information is included in Appendix B.

FY 2005

- Stoney Beach Road Sewer Correction

FY 2006

- Moreland Ave Sewer Over 350 feet of force main installed; Whole Sagamore Area sewer redesigned. Draft plans first made in 2003
- Repair main line at Beacon and Bradford Street
- Repair lateral at 26 Bay Street
- Excavated old sewer main at Sea View and Atlantic Ave
- Repair lateral at 208 Atlantic Ave
- Repair broken line lateral at 16 Atherton Street
- Sewer main repair at 14 Whitehead Ave
- Replaced lateral at 25 Main and Vautrinot Street
- Repair 14" Main line at Atlantic and Nantasket Ave Emergency repair during Memorial day weekend Some damage to homes
- Berkley Atherton Street sewer correctionGroundwater infiltration during correction which delayed work completion time significantly

FY 2007

- 110' sewer line on Main Street in 2006 plans to investigate PS 9 area (including Main St.) were made, sewer line repair was due to infiltration discoveries
- Repair Sewer lateral at 95 Nantasket Ave
- Repair sewer lateral and Main Line at 258 Nantasket Ave
- New 6" lateral at Standish Ave
- Repair clay sewer and lateral at 29 Point Allerton

FY 2008

- Sewer lateral at 41 Point Allerton

FY 2009

- Sewer Lateral at 46 Point Allerton
- Sewer lateral repair at 42 Point Allerton
- Replace collapsed sewer main at 19 Hampton Circle
- Beacon Road Sewer Extension Gravity sewer rehab project that started in 2007; Additional manholes installed

FY 2010

- Install 8" PVC feet of pipe at Coast Guard Station

FY 2011

- Repair 10" Force Main at Pump Station 9
- Repair 10" Force Main at Pump Station 9
- Repair 10" force main pump by 1149 Nantasket Ave
- Repair low pressure main at Duck Lane

FY 2012

- Spring Street sewer line repair between Crest and Lafayette-Newton Street sewer line repair Manhole collapse
- Pump St. 9 force main replacement Hydrogen sulfide corrosion
- Pump St. 9 force main engineering
- 12" VC line repair at manhole 4-1122 Nantasket Ave
- Replaced 12" VC line at manhole 5 1118 Nantasket Ave

FY 2013

- Replace 82 feet of clay line with PVC Reef Point

FY 2014

- Repair force main at Pump Station 4 Marginal Road
- Repair Low pressure sewer main at Rockview and Rockaway
- Repair sewer main at Porazzo Road
- Repair sewer lateral at 276 Nantasket Ave
- Repair sewer pipe at 269 Nantasket Ave
- Repair sewer line at 64 Holbrook Street
- Repair 134 Atlantic Ave sewer lateral
- Repair low pressure force main between 1-9 Rowley Street Blockage in the 2" low pressure line
- Repair 87 Bay Street lateral
- Repair collapsed sewer main at Water Street During the project an abandoned line was discovered to be open to the tidal ocean inflow on Water Street

FY 2015

- Miscellaneous manhole frames and covers
- Repair to sewer lateral at 520 Nantasket Ave
- Repair 2 broken pipes at 271 Nantasket Ave

FY 2015 (continued)

- Repair sewer main at 262 Atlantic Ave
- Trenchless sanitary sewer line repair, installation of CIPP short liner

C. PUBLIC & PRIVATE INFLOW

Since 2007, the Town of Hull Sewer Department has implemented an inspection program through the Sewer Department to identify and abate illegal sump pumps and other private inflow sources. See Appendix B for detailed costs of the following improvements and Appendix D for the Town of Hull Sewer Code excerpt pertaining to inflow abatement.

FY 2005

- Valley Beach Ave (near Pump Station A, PS A) showed significant sources of inflow
- Smoke testing revealed storm water catch basins were attached to sewer system (Redirected)
- Separated storm drain at Maple Way
- Catch basin at parking lot of Nantasket Beach (owned by Department of Conservation and Recreation, DCR), judged to be substantial source of inflow

FY 2006

- Infrastructure of sewer investigated for PS 1, A, 4, and 9.
- Repairs include manholes on Glover Street (1), Point Allerton (1), and Rockview Ave (1)
- Pump Station 9 Area (Hull Village) of concern

FY 2007

- Smoke testing of 18,000 ft. of pipe performed near pump station 9, minor pipe fix's made, insignificant sources of inflow were found
- Adoption of changes to Town of Hull Bylaws to help identify private inflow sources
- Two meter rings installed in Hull village area for 3 months to record flows from 2 separate rain events (>2 inches/day)
- A lot of work was done in the Atlantic Ave/Nantasket Ave due to a smoke test performed back in '03- '04 indicating "a large number of small sources" contributing to PS 1's flow

FY 2008

- More minor work done on Atlantic Ave (1 manhole repair) and another done in the village area (1 manhole on Holbrook Ave)
- More flow meters installed prior to certain rain events on lines of potential I/I sources

FY 2009

- Primary focus on infiltration and fixing pipeline, 1 manhole repair documented on Richards Road (off of Atlantic Ave)

FY 2010

- Meridian/Kenton, Halverson/Circuit, and Highland Ave all had manhole repairs

FY 2011

- Manhole recovers and repairs

FY 2012

- Fitzpatrick Way had two manholes repaired that were taking water in on high tide

FY 2013

- A significant amount of manhole repairs, over 20, which included frame and cover replacement or repair occurred throughout the town at various locations.
- Sewer line inspection (10,000 ft./year)

FY 2014

- The plant experienced a major failure in 2013 in which the plant's focus shifted from I/I towards fixing and maintaining the plant.

FY 2015

- Sewer manholes at Bay street and Manomet/Coburn rebuilt

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D. ANNUAL ESTIMATES OF I/I

D.1 PEAK I/I

During periods of elevated groundwater levels and storm events, infiltration and inflow into the collection system will be at its highest. For determining the 2015 Peak I/I and Total I/I values, the following parameters were evaluated using the best available information from January 1, 2015 through December 31, 2015:

- Daily Precipitation
- Average Daily Groundwater Level
- Daily WWTF Plant Effluent Flow
- Hourly Pump Station Flows

The following peak I/I estimates were based off of I/I calculation guides developed by the EPA and Mass DEP. Daily WWTF Effluent Flow and Precipitation data was exported from the Plant's Hach® WIMS™ data management system, and Pump Station flow rates were calculated from Hach® WIMS™ start/stop data. Refer to Appendix A for a list of all equations and Appendix D for calculations pertaining to the peak I/I estimation.

Infiltration Calculations

Data from 2015 was analyzed and the following precipitation and effluent flow data was compiled from plant records in Figure 1 below. For the lowest period of rainfall (7-day dry weather period) between March 28 and April 3, 2015, peak infiltration was calculated.

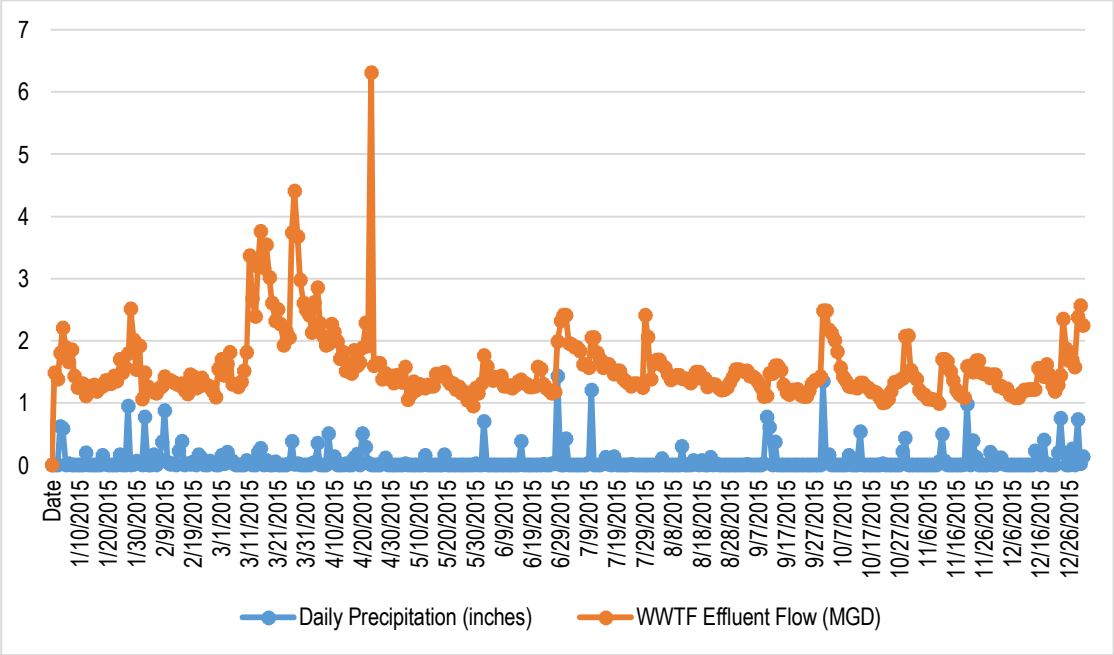


Figure 1: 2015 Daily Effluent Flow and Precipitation

Also within the period of interest (POI), the groundwater level recorded at the nearest USGS Weather Station (Duxbury, MA) showed a high groundwater period at this time, as shown in Figure 2. Using pump station flows, the peak infiltration estimate was calculated over nighttime flows (between 12am and 6am).

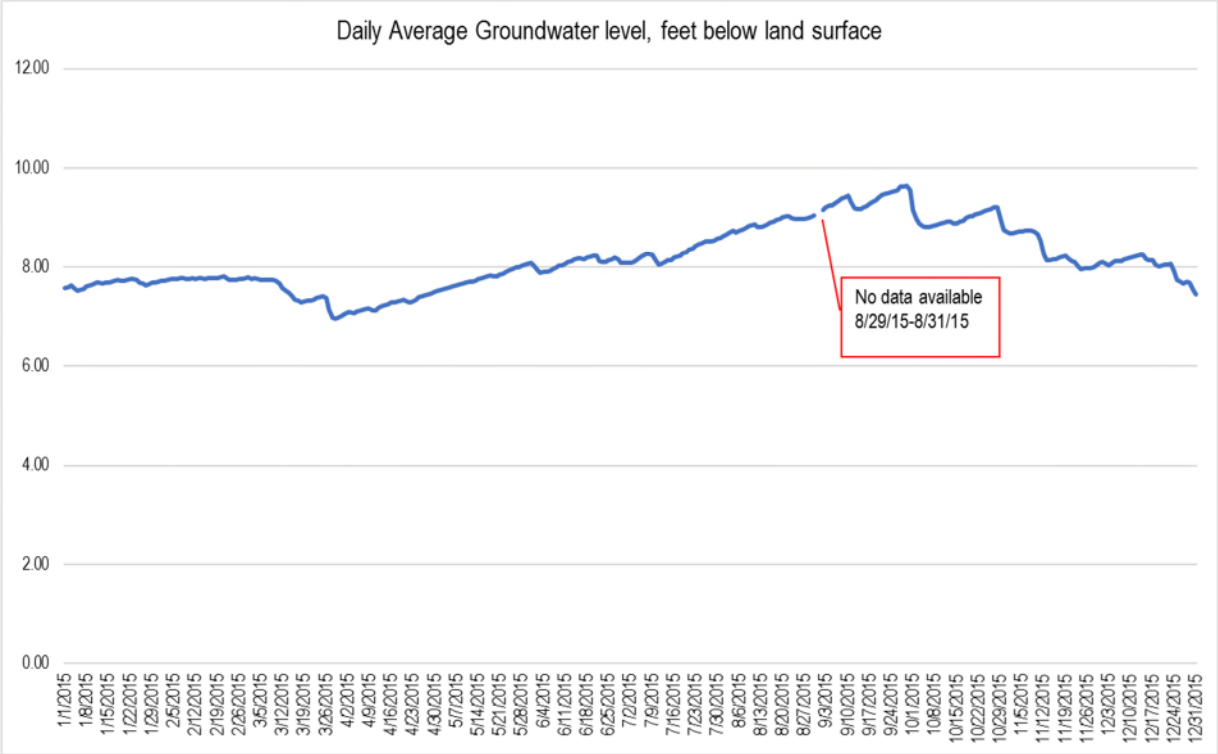


Figure 2: Average Daily Groundwater Level, USGS Duxbury MA Station

Inflow Calculations

A majority of the inflow that enters the collection system is from manhole frames and covers, after heavy rain or storm events. Wet-weather periods were assumed to be storms with precipitation of 0.05" or greater.

The following criteria and variables were applied in the peak inflow estimate:

- Wet weather flow periods or storm events
- Base sanitary flow estimate
- Peak infiltration estimate

Pump Station 3 GWI Flow Estimate

Pump Station flow rates were used to determine hourly flows for the low-flow time period. Pump Station 3 is the only station without a flow meter, therefore the flows were assumed by comparing the effluent flow from the plant to the sum of flows from the collection system. A summary of Pump Station 3's GWI flow estimate may be reviewed below in Table 3.

Table 3: Pump Station Flow Estimate

Station #	Average Daily Flows during POI (gpd)	Average Nighttime Flows during POI (gpd)
9	690,000.00	78,723.00
5	165,143.00	44,522.00
6	23,000.00	8,401.00
4	210,143.00	51,055.00
Total Actual Flow	1,088,286.00	182,701.00
3 (Estimated)	1,611,714.00	402,928.50
Total (Actual and Estimated) Station Flow	2,700,000.00	585,629.50

D.2 TOTAL YEARLY I/I

The total yearly I/I estimate is developed based off of the average annual I/I. Refer to Appendix A for information regarding the equations and parameters used for the estimate.

Table 4: Annual Estimate for the 2015 I/I

	Million Gallons
Peak Daily I/I:	1.01
Total Yearly I/I:	7.67

E. FUTURE I/I CONTROL PLAN

Plan of Action

Building off of the existing program, cleaning and inspecting priorities will be enhanced to provide the Town of Hull with improved methods of identifying, estimating, and correcting sources of potential I/I to the collection system.

After developing the 2015 I/I control plan, the following recommendations for improving I/I calculations will be implemented:

- Automate flow reporting from the pump stations to more accurately determine flows on an ongoing basis via SCADA to help track excessive I/I sources
- Update SCADA to record hourly pump station flow data
- Add tidal and groundwater data to Hach® WIMS™ and/or SCADA
- Install a groundwater monitoring well at the plant or in a close vicinity
- Incorporate salinity testing at pump stations and WWTF

Over the next few months, SCADA will be improved to estimate flow rates for all Pump Stations and tidal data, retrieved from the Town of Hull website, will be added to Hach® WIMS™. In addition to updating SCADA, a groundwater monitoring well is to be installed either at the treatment facility or at some location in Hull. This will allow the documentation of groundwater levels, which is a vital component to any infiltration estimate. By having groundwater monitoring in the town, there will be a more exact measurement of the varying groundwater table that is actually present in Hull. Once the I/I data collection methods and instrumentation is implemented, additional I/I studies and approaches are to be explored in the next few years. Future goals for tracking I/I into the collection system will be to implement salinity and smoke testing as well as to improve documentation of private inflow sources.

APPENDIX A: ABBREVIATIONS AND EQUATIONS

Appendix A

TERMS

Average Annual Flow (AAF): A mean flow value estimated from effluent flows over 365 days a year

Average Dry Weather Flow (ADWF): A mean flow value estimated from the period of interest

Base Sanitary Flow (BSF): A sanitary wastewater flow estimate that does not include any infiltration or inflow

Groundwater Infiltration Flow (GWI): A sanitary wastewater flow estimate predicted over the period of interest. This flow reflects hourly pumping rates from the collection system pump stations.

Average Wet Weather Flow (AWWF): A mean flow value estimated from effluent flow over precipitation exceeding 0 inches.

Inflow: Water that enters the collection system above ground collection system infrastructure through defaults in manholes covers, drains, roof leaders, or cross connections.

Infiltration: Water that enters the collection system underground collection system infrastructure through defaults in pipes, manholes, mains, or connections.

Period of Interest (POI): 7 consecutive days with little to no precipitation during significantly high ground water over nighttime 12-6 AM.

Pump Station Draw Downs: Calculations that serve to estimate pumping rates from various pump stations. The parameters that comprise the calculations include wet well volumes, wet well elevation levels, and times used to start/stop/start the pumps. The Pump Station Draw Down calculations consist of an Inflow Rate and a Pumping Rate.

EQUATIONS

1) GWI = $\sum$ Average hourly flow rates over peak I/I conditions at nighttime from various pump stations
2) BSF = ADWF – GWI
3) Infiltration = BSF – GWI
4) Inflow = AWWF – [BSF + GWI]
5) Peak I/I = Peak Inflow + Peak Infiltration *Over period of interest
6) Average Annual I/I = AAF – BSF
7) Total Annual I/I = [Average Annual I/I] x 365 Days
8) Inflow Rate into Pump Station (*gallons per hour*) = Volume of Wet Well / Change in Time Pump Stop to Begin Pump Start
9) Hourly Pumping Rate (*gallons per hour*) = Inflow Rate + [Volume of Wet Well / Change in Time Pump End to Pump Stop]

10) Average Nighttime Flow over the POI = Mean of Inflow Rates for each Pump Station over the POI
11) Average Daily Flow over the POI = Mean of 365 day values of [Mean Pumping Rate for each Pump Station over the POI x Pump Station Run Total Daily Run Time]
12) Average of Percent of that Nighttime Contributes to the Daily Total over POI = Average Nighttime Flow over the POI / Average Daily Flow over the POI
13) Pump Station 3 Flow Estimate = Average of Percent of that Nighttime Contributes to the Daily Total over POI x Average Nighttime Flow Rate over POI for Pump Station 3

APPENDIX B: HISTORIC SEWER REHABILITATION INVOICE RECORDS

Town of Hull Sewer Department
Summary of I/I Projects Funded, August 2016

FY	Amount Spent
2005	$ 40,223.50
2006	$ 463,667.59
2007	$ 594,563.84
2008	$ 101,595.00
2009	$ 240,351.21
2010	$ 41,735.00
2011	$ 80,715.08
2012	$ 2,299,043.31
2013	$ 107,033.32
2014	$ 153,969.81
2015	$ 131,121.58
Total	**$ 4,254,019.24**

Fiscal Year	Contractor	Invoice Date	Work Done Date	Type of Work	Amount
2015	EJ USA	9/24/2014	9/23/2014	frames and covers	$ 2,974.58
2015	Hub Construction	6/15/2015	8/29 - 9/2 & 9/13/2014	reset frames and covers at Manomet Coburn and Lewis Massasoit Guild Stafford Summer ST Warfield Ave Draper Ave and Telegraph	$ 11,905.00
2015	Hub Construction	6/15/2015	9/9 9/19 9/23/2014	Lowered 3 sewer frame & covers at Water ST Bay St and Nantasket Rebuilt 2 sewer manholes at Water St and Bay Street	$ 14,835.00
2015	Hub Construction	3/20/2015	3/17/2015	Repair collapsed sewer manhole at 13 Highland Ave	$ 2,798.00
2015	Hub Construction	3/3/2015	2/26/2015	repair/replace sewer frame and cover Nantasket ave at Irwin Street	$ 1,620.00
2015	Hub Construction	2/20/2015	2/14/2015	manhole frame and cover at G Street	$ 2,577.50
2015	Hub Construction	1/15/2015	11/13/2014	emergency repair to sewer lateral at 520 Nantasket Ave	$ 32,902.50
2015	Hub Construction	1/8/2015	8/25/2014	rebuilt sewer manholes new frames and covers 121 Bay St 132 Bay St Island View and Bay Street	$ 6,290.00
2015	Hub Construction	1/8/2015	8/27/2015	rebuilt sewer manholes new frames and covers Lewis & Manomet 131 Manomet Coburn & Manomet and 109 Manomet	$ 7,770.00
2015	Hub Construction	10/29/2014	10/15/2014	repair 2 broken pipes at 271 Nantasket Ave	$ 844.00
2015	Hub Construction	9/26/2014	9/11 & 9/12/2014	repair sewer main at 262 Atlantic Ave	$ 6,035.00
2015	Inland Waters	1/23/2015	1/21/2015	Trenchless sanitary sewer line repair, installation of CIPP short liner	$ 3,750.00
2015	Kleinfelder	various	July - December 2014	CCTV Inspection Review/GIS Mapping	$ 36,820.00

Fiscal Year	Contractor	Invoice Date	Work Done Date	Type of Work	Amount
2014	DiVito	8/15/2013		Manhole frame and cover	$ 338.41
2014	Hoadley	5/16/2014	5/14/2014	Purchase of manhole covers and frames	$ 979.20
2014	Hoadley	4/15/2014	4/9/2014	Purchase of manhole covers and frames	$ 979.20
2014	Hub Construction	6/27/2014		repair 6 Atherton Rd	$ 1,425.00
2014	Hub Construction	6/11/2014	5/29/2014	repair 87 Bay Lateral	$ 4,360.00
2014	Hub Construction	5/21/2014	2/12/2014	Inspection of sewer pipes at long beach, state park, midledge and Valley Beach	$ 2,160.00
2014	Hub Construction	5/21/2014	4/28-4/30/14	repair collapsed sewer main at Water Street. During the project an abandoned line that was open to the tidal ocean inflow on Water Street was discovered and capped - see April 30, 2014 minutes	$ 98,433.00
2014	Hub Construction	3/5/2014	2/14/2014	Repair force main at pump station 4 Marginal Road	$ 17,287.00
2014	Hub Construction	3/5/2014	3/3/2014	repair collapsed manhole 162 Hampton Circle	$ 1,695.00
2014	Hub Construction	1/23/2014	1/8 -1/9/14	repair low pressure sewer main at Rockview and Rockaway	$ 6,605.00
2014	Hub Construction	12/10/2013	12/5/2013	repair sewer main at Porazzo Rd	$ 405.00
2014	Hub Construction	12/4/2013	12/2/2013	repair sewer lateral at 276 Nantasket Ave	$ 325.00
2014	Hub Construction	11/6/2013	10/25/2013	repair sewer pipe at 269 Nantasket Ave	$ 1,183.00
2014	Hub Construction	11/6/2013	10/16/2013	repair sewer line at 64 Holbrook Ave	$ 2,585.00
2014	Hub Construction	8/29/2013	8/23-8/24/13	repair low pressure force main between 1-9 Rowley	$ 11,890.00
2014	Hub Construction	8/8/2013		Repair 134 Atlantic sewer lateral	$ 3,320.00

Fiscal Year	Contractor	Invoice	Work Done	Type of Work	Amount
2013	DiVito	1/15/2013	11/20/2012	Replace 82 Feet of clay line with PVC Reef Point	$ 4,650.00
2013	EJ USA	5/7/2013	5/6/2013	frames and covers	$ 459.10
2013	EJ USA	12/11/2012	12/10/2012	frames and covers	$ 1,099.22
2013	EJ USA	12/20/2012	12/19/2012	frames and grate	$ 2,267.40
2013	Hoadley	1/9/2013	1/7/2013	frames and covers	$ 405.60
2013	Hoadley	12/21/2012	12/19/2012	frames and covers	$ 442.00
2013	Hub Construction	6/6/2013	11/28/2012	removed broken sewer frames and covers C ST and Cadish - D street and Cadish - Cadish and Sunset - Cadish and G - Cadish and E st	$ 4,110.00
2013	Hub Construction	6/6/2013	11/29/2012	frames and covers Sunset Ave #4 - 12- 14-20-24-26 and 34	$ 3,742.50
2013	Hub Construction	6/6/2013	11/30/2012	frames and covers at Rockland circle and Rockland house road	$ 3,485.00
2013	Hub Construction	6/6/2013	12/3/2012	frames and covers Nantasket Ave by Menice Field - intersection of Shore Garden and Nantasket Ave - 91 Nantasket Ave	$ 3,805.00
2013	Hub Construction	6/6/2013	12/4/2012	frames and covers Nantasket Ave, Atlantic Ave, Meade Ave Summit 280 Atlantic D Street at Nantasket - P Street at Nantasket Ave	$ 3,615.00
2013	Hub Construction	6/6/2013	12/6/2012	Frames and covers on Duck Lane	$ 3,600.00
2013	Hub Construction	6/6/2013	12/7/2012	Frames and covers Nantasket at School ST, Nantasket at Water Street and Nantasket at Shore Drive	$ 3,625.00
2013	Hub Construction	6/6/2013	12/11/2012	Frames and covers #206 216 236 238 249 254 268 282 Nantasket Road 282 Osmunden	$ 3,700.00
2013	Hub Construction	6/6/2013	12/12/2012	frames and cover 96 and 196 Nantasket Rd and intersections of Nantasket Road at 6th 7th 8th 9th 10th and 11th Ave	$ 3,805.00
2013	Hub Construction	6/6/2013	12/13/2012	frames and covers at Standish and Hampton Circle, Clifton Ave and Nantasket Rd - rebuilt top section of manholes at 68 78 86 Clifton - 47 57 68 86 Edgewater	$ 4,190.00
2013	Hub Construction	6/6/2013	12/14/2012	frames and covers 955 Nantasket Ave - 22 Pt Allerton - Pt Allerton at Holbrook	$ 4,150.00

Fiscal Year	Contractor	Invoice	Work Done	Type of Work	Amount
2013	Hub Construction	6/6/2013	12/18/2012	frames and covers at 31 Atlantic House Rd - Atlantic House Rd and Central Ave - Atlantic House Rd and Atlantic Ave - Central Ave and D St - Central Ave and B st	$ 3,530.00
2013	Hub Construction	6/6/2013	12/19/2012	frames and covers - Atlantic House Rd and Midledge - 19 27 Midledge Ave - 9 State Park Rd 38 Atlantic House Rd	$ 4,790.00
2013	Hub Construction	6/6/2013	12/20/2012	Frames and covers - rebuilt cones - replaced broken frames - Whitehead and 5th st - Whitehead and 4th St - Whitehead and Nantasket - 45 Park Ave - Park Ave at Ralph Crossen	$ 4,465.00
2013	Hub Construction	6/6/2013	12/26/2012	Frames & Covers 24 & 52 Mede Ave - Valley Beach at pump station - 20 32 38 Valley Beach Maple Way at Valley Beach	$ 4,660.00
2013	Hub Construction	6/6/2013	12/28/2012	Frames & Covers at 225 Beach Ave 66 B St 63 C St 80 G St - F street at Beach Ave - E Street at Beach Ave and H Street at Beach Ave	$ 4,645.00
2013	Hub Construction	6/6/2013	1/7/2013	Frames & Covers at Adams ST and Beach Ave - Alden and Manomet and 89 Manomet	$ 4,140.00
2013	Hub Construction	6/6/2013	1/8/2013	Frames & Covers at 25 A St 28 O St Q ST at Central Ave - G st at Central Ave H St at Central Ave K St at Central and L St at Central ave	$ 3,572.50
2013	Hub Construction	6/6/2013	1/9/2013	Frames and covers 67 & 76 D St - 72 & 77 E St - 68 H St 61 K St and 46 P St	$ 3,845.00
2013	Hub Construction	6/6/2013	1/10/2013	Frames and covers F st Central - 33 & 49 E St - 37 G St - 37 J St 15 K St and 32 & 44 L St	$ 3,700.00
2013	Hub Construction	6/6/2013	1/11/2013	Frames and covers - 39 B ST - 57 Westminster - 5&9 Moreland	$ 3,375.00
2013	Hub Construction	5/29/2013	5/15/2013	Patched manhole at side entrance to plant on Nantasket Ave	$ 425.00
2013	Hub Construction	1/29/2013	8/5 & 8/6/12	rebuilt top of basins new frames and covers 169-175 Spring St	$ 3,180.00
2013	Hub Construction	2/22/2013	8/6 &8/7/12	rebuilt top of basins new frames and covers 95-102 Highland Ave and 10 Andrew	$ 4,825.00
2013	Hub Construction	11/27/2012	11/16/2012	reset and repaved sewer manhole covers on Central Ave from A to Q st	$ 3,805.00
2013	Hub Construction	11/27/2012	7/25/2012	replaced two existing frames and covers on Vautrinot	$ 2,925.00

Fiscal Year	Contractor	Invoice Date	Work Done Date	Type of Work	Amount
2012	Aqua Line	7/26/2011	7/1/2011	Spring ST Sewer Line Repair between Crest & Laafayette - Newton ST Sewer Line repair	$ 20,673.26
2012	D'Allessandro	various	various	Pump station 9 Force Main Replacement	$ 668,775.95
2012	Tighe & Bond	various	various	Pump station 9 Force Main Replacement engineering	$ 159,134.00
2012	Lash	various	various	Sewer Pipeline Renewal Project (lining project)	$ 1,295,025.10
2012	Kleinfelder	various	various	Sewer Pipeline Renewal Project (lining project) engineering	$ 136,430.00
2012	Hub Construction	12/30/2011	12/14/2011	Installed 2 Water Tight covers at Martin Luther King Bridge (these were taking on water at high tide)	$ 1,562.00
2012	Hub Construction	12/12/2011	9/14/2011	12" VC line repair at manhole 4 - 1122 Nantasket Ave	$ 3,950.00
2012	Hub Construction	10/4/2011		Pump Station 6 conduit run to sewer manhole at L St	$ 4,893.00
2012	Hub Construction	9/22/2011	9/13/2011	Replaced 12" VC Line ay manhole 5 1118 Nantasket Ave	$ 3,950.00
2012	Inland Waters	8/5/2011	8/3/2011	removal of protruding tap	$ 2,700.00
2012	NRP	7/19/2011		Professional services for control of H2S levels at PS 1, PS 3, PS A and West Corner	$ 1,950.00

Fiscal Year	Contractor	Invoice Date	Work Done Date	Type of Work	Amount
2011	Bowker & Associates		June - Dec 2010	engineering for sulfide control to prevent corrosion	$ 19,850.00
2011	Greyline	7/14/2010		Potable Doppler Flow Meter	$ 3,982.50
2011	Hub Construction	1/12/2011	1/7/2011	Repair 10" Force Main Pump Station 9	$ 9,070.00
2011	Hub Construction	6/23/2011	1/19/2011	Repair 10" Force Main Pump Station 9	$ 19,632.50
2011	Hub Construction	6/23/2011	8/12/2010	Covers & Frames Spring & Main St	$ 1,600.00
2011	Hub Construction	4/13/2011	4/12/2011	Repair 10" Force Main Pump by 1149 Nantasket Ave	$ 9,812.50
2011	Hub Construction	4/15/2011	9/3/2010	Repair Low Pressure Main at Duck Lane	$ 4,245.00
2011	Hub Construction	2/16/2011	2/14/2011	Ocean Ave & Railroad bed cut out 10" section of main for observation	$ 5,275.00
2011	Hub Construction	1/26/2011	12/30/2010	Frame & Cover sewer manhole at 1141 Nantasket Ave	$ 765.00
2011	Hub Construction	1/26/2011	12/16/2010	Frame & Cover sewer manhole at Meridian & Holbrook	$ 1,425.00
2011	Hub Construction	8/3/2010	7/23/2010	Frame & Cover sewer manhole at Harborview rebricked top section of manhole	$ 1,606.00
2011	USA Bluebook	9/17/2010	9/16/2010	I&I Spy Inflow & Infiltration Monitor	$ 3,451.58

Fiscal Year	Contractor	Invoice Date	Work Done Date	Type of Work	Amount
2010	Hub Construction	6/10/2010	6/9/2010	Manhole replace frames and covers - Meridian & Kenton, Halverson & Circuit & Highland Ave	$ 2,650.00
2010	Hub Construction	9/10/209	9/10/2009	Replaced top section of water box at Draper Ave Pump Station	$ 995.00
2010	Kleinfelder	various		Sulfide Mitigation	$ 28,205.00
2010	Struzziery Construction	6/28/2010		Install 8" PVC 35 feet of pipe at the Coast Guard Station	$ 9,885.00

Fiscal Year	Contractor	Invoice Date	Work Done Date	Type of Work	Amount
2009	Blue Diamond	various		Beacon Rd Sewer Extension	$ 217,103.71
2009	Hub Construction	6/30/2009	7/1/2008	sewer lateral at 46 PT Allerton	$ 8,750.00
2009	Hub Construction	6/30/2009	7/2/2008	sewer lateral at 42 PT Allerton	$ 8,750.00
2009	Hub Construction	3/10/2009	2/16/2009	Manhole cover and frame at 5 Richards Rd	$ 780.00
2009	Hub Construction	9/16/2008	9/12/2008	replace collapsed sewer main at 19 Hampton Circle	$ 4,967.50

		Invoice	Work Done	Type of	
Fiscal Year	**Contractor**	**Date**	**Date**	**Work**	**Amount**
2008	Hub Construction	6/25/2008	12/18/2007	remove and reset manhole Atlantic Ave	$ 835.00
2008	Hub Construction	6/25/2008	12/17/2007	frames and covers at Holbrook Ave	$ 800.00
2008	Hub Construction	6/30/2008	6/30/2008	sewer lateral at 41 PT Allerton	$ 8,750.00
2008	Hub Construction	6/30/2008	6/10/2008	new valves between 41 & 50 Pt Allerton	$ 8,750.00
2008	Hub Construction	6/24/2008	6/23/2008	repair low pressure main at Duck Lane	$ 2,360.00
2008	Iaria Bros	7/31/2007		replace manhole covers	$ 2,200.00
2008	Woodard & Curran	various		engineering for beacon and Bradford project	$ 77,900.00

		Invoice	Work Done	Type of	
Fiscal Year	**Contractor**	**Date**	**Date**	**Work**	**Amount**
2007	Aqua Line	11/18/2006		6 manhole frames and covers	$ 2,600.00
2007	EST	12/31/2006	12/28 & 12/29/06	17,696 ft of Smoke Testing	$ 7,609.28
2007	F Riley	7/31/2006		110' sewer lie on Main St	$ 15,050.00
2007	Hub Construction	6/27/2007	6/6/2007	repair sewer lateral at 95 Nantasket Ave	$ 2,555.00
2007	Hub Construction	6/29/2007	6/29/2007	repair sewer lateral at main line at 258 Nantasket Ave	$ 2,296.00
2007	Hub Construction	6/29/2007	5/9/2007	New 6" lateral at Standish Ave	$ 4,740.00
2007	Hub Construction	6/29/2007	6/5/2007	sewer manholes Pt Allerton and Stony Beach Rd	$ 710.00
2007	Hub Construction	7/3/2007	6/7/2007	repair clay sewer and lateral at 29 Pt Allerton	$ 8,750.00
2007	Pat Irwin	various		Monitor I&I/H2S Monitoring and Sampling	$ 1,325.00
2007	Insituform	various		Atlantic/Nantasket Ave sewer renewal and manhole work	$ 507,944.06
2007	National Water Main	8/28/2006	8/1/2006	clean and TV lines for Nantasket Ave - spring St and Bradford	$ 2,914.60
2007	SEA	various		Engineering for sewer renewal	$ 9,500.00
2007	Teledyne Isco Inc	various		purchase of meters rings and assembly	$ 28,569.90

		Invoice	Work Done	Type of	
Fiscal Year	**Contractor**	**Date**	**Date**	**Work**	**Amount**
2006	D&C Construction	Various		Moreland Ave Sewer	$ 72,240.08
2006	Hub Construction	6/2/2006	9/16/2005	Manhole at end of low pressure system on Rockview	$ 1,915.52
2006	Hub Construction	6/28/2006	6/1/2006	Repair manhole at Pt Allerton	$ 975.00
2006	Hub Construction	5/31/2006	5/24/2006	repair to main line beacon and Bradford	$ 5,774.00
2006	Hub Construction	6/28/2006	6/7 & 6/9/06	repair lateral at 26 Bay St	$ 5,960.00
2006	Hub Construction	6/15/2006	3/9/2006	excavated old sewer main at sea view and Atlantic and plugged	$ 2,565.00
2006	Hub Construction	5/10/2006		repair lateral at 208 Atlantic Ave	$ 3,642.00
2006	Hub Construction	3/23/2006	3/22/2006	repair broken line lateral at 16 Atherton	$ 2,240.00
2006	Hub Construction	12/2/2005	10/7/2005	sewer repair Glover Ave	$ 1,667.50
2006	Hub Construction	10/3/2005	9/20/2005	sewer main repair at 14 whitehead ave	$ 2,901.00
2006	Hub Construction	8/23/2005	8/19/2005	replaced lateral 25 Main and Vautrinot	$ 2,300.00
2006	Hub Construction	6/30/2005	various	Repair 14" main line at Atlantic and Nantasket Ave	$ 148,463.70
2006	Insituform			see 2007 report - crossed years	
2006	Pat Irwin	Various	various	Monitor I&I/H2S Monitoring and Sampling	$ 350.00
2006	L Perrina Construction	Various	various	Berkley Atherton sewer	$ 104,503.41
2006	SEA	Various	various	sewer rehab engineering Atlantic & Nantasket Ave contract	$ 82,300.00
2006	SEA	4/4/2005	various	Berkley Atherton evaluation	$ 2,000.00
2006	Woodard & Curran	Various	various	Berkley Atherton sewer correction	$ 23,870.38

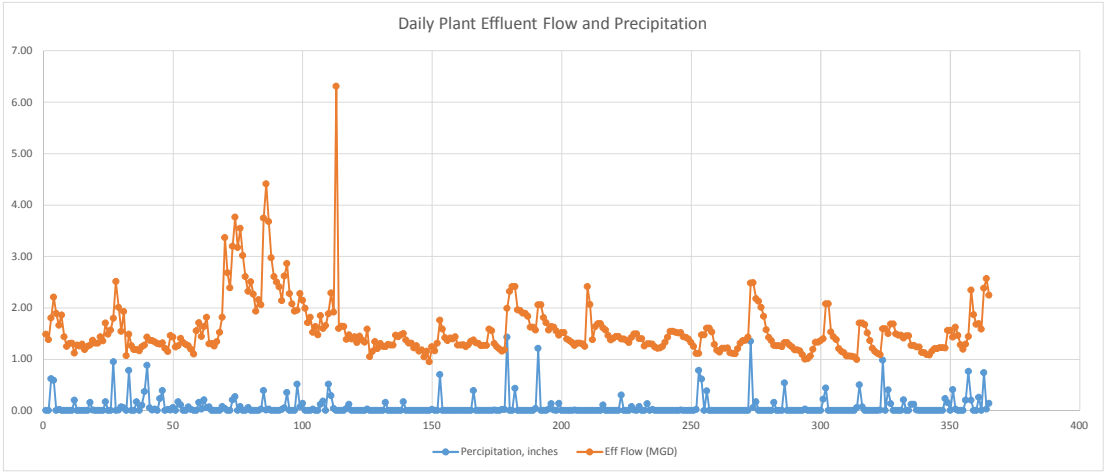
		Invoice	Work Done	Type of	
Fiscal Year	Contractor	Date	Date	Work	Amount
2005	Hub Construction	11/28/2004	11/22/2004	separated storm drain from sewer main in line near 7 maple way	$ 2,855.00
2005	Hub Construction	2/6/2005	1/27/2005	repair manhole at 667 Nantasket Ave	$ 1,205.00
2005	Hub Construction	1/26/2005	1/19/2005	repair at park ave and Rockland house road	$ 1,538.50
2005	Hub Construction	6/27/2005	6/13/2005	repair at Adducci Way and Ocean Ave	$ 925.00
2005	Woodard & Curran	various	various	I&I Assessment	$ 26,400.00
2005	Woodard & Curran	various	various	Stony Beach Rd sewer correction	$ 7,300.00

APPENDIX C: INFILTRATION AND INFLOW DATA

Period of Interest: 3/28-4/3 @ 12-6am							
Date & Time	GW level, ft below surface	Hourly Inflows, gpm Station 1 (Draw Down Tests)	Average Daily Flow Station 3 (Draw Down Tests)	Hourly Inflows, gpm Station 9 (Draw Down Tests)	Hourly Inflows, gpm Station 5 (Draw Down Tests)	Hourly Inflows, gpm Station 6 (Draw Down Tests)	Hourly Inflows, gpm Station 4 (Draw Down Tests)
3/28/2015 0:00	7.01	236.25	850,000.00	294.30	166.57	34.11	234.13
3/28/2015 1:00	7.01	205.67		251.74	168.04	31.36	242.34
3/28/2015 2:00	7	242.50		296.45	151.64	31.83	195.29
3/28/2015 3:00	7	258.50		229.67	131.66	25.63	399.47
3/28/2015 4:00	6.99	208.08		321.79	157.92	58.45	216.83
3/28/2015 5:00	6.99	258.50		307.00	136.44	29.62	230.31
3/28/2015 6:00	6.98	231.42		290.12	160.59	31.76	152.37
3/29/2015 0:00	6.96	253.75		195.69	179.71	26.92	159.07
3/29/2015 1:00	6.96	218.08		272.39	157.16	25.79	163.46
3/29/2015 2:00	6.96	263.92		239.98	131.66	24.03	160.26
3/29/2015 3:00	6.96	245.92		275.28	100.48	23.21	194.14
3/29/2015 4:00	6.96	245.83		216.10	159.31	9.99	175.45
3/29/2015 5:00	6.96	252.58		233.70	120.33	24.43	170.54
3/29/2015 6:00	6.96	294.25		246.15	139.09	23.06	155.90
3/30/2015 0:00	6.98	239.75		232.98	129.14	28.95	175.14
3/30/2015 1:00	6.98	227.00		225.83	140.30	10.31	183.84
3/30/2015 2:00	6.98	220.17		222.90	109.15	19.60	179.16
3/30/2015 3:00	6.98	256.00		212.98	123.51	9.09	159.77
3/30/2015 4:00	6.98	228.08		193.57	124.64	19.19	163.85
3/30/2015 5:00	6.98	230.33		231.43	110.75	23.95	195.12
3/30/2015 6:00	6.98	252.75		179.15	131.01	29.31	160.88
3/31/2015 0:00	6.99	208.92		206.81	134.19	22.24	139.01
3/31/2015 1:00	6.99	228.50		184.69	107.96	19.40	157.15
3/31/2015 2:00	7	228.33		183.62	117.75	21.61	131.48
3/31/2015 3:00	7	231.25		191.73	119.73	9.55	139.00
3/31/2015 4:00	7	230.50		190.18	105.23	16.23	145.22
3/31/2015 5:00	7	204.67		189.70	113.76	20.41	109.46
3/31/2015 6:00	7	211.83		191.54	158.44	27.36	151.80
4/1/2015 0:00	7.04	214.42		214.78	134.40	23.81	129.45
4/1/2015 1:00	7.04	206.92		233.31	117.51	18.24	132.45
4/1/2015 2:00	7.04	292.92		214.21	113.21	18.53	134.74
4/1/2015 3:00	7.04	235.58		212.22	80.22	16.69	149.03
4/1/2015 4:00	7.04	215.42		192.52	107.93	16.53	143.76
4/1/2015 5:00	7.04	224.00		125.23	103.24	21.16	142.61
4/1/2015 6:00	7.04	207.67		200.42	99.02	44.14	148.66
4/2/2015 0:00	7.08	189.58		200.72	142.68	19.07	121.53
4/2/2015 1:00	7.08	254.75		184.49	112.46	15.48	119.62
4/2/2015 2:00	7.08	285.08		201.41	105.10	32.78	118.27
4/2/2015 3:00	7.08	205.83		197.61	104.41	6.69	125.98
4/2/2015 4:00	7.08	270.75		179.74	97.53	15.13	98.32
4/2/2015 5:00	7.09	268.00		232.32	109.02	16.78	130.18
4/2/2015 6:00	7.09	243.33		216.91	147.21	26.88	137.39
4/3/2015 0:00	7.08	283.75		217.29	119.29	26.79	136.10
4/3/2015 1:00	7.09	193.92		211.22	105.63	21.33	110.70
4/3/2015 2:00	7.09	192.08		187.02	98.56	18.01	142.27
4/3/2015 3:00	7.08	207.83		225.74	96.78	18.78	144.79
4/3/2015 4:00	7.08	214.33		186.55	90.08	19.21	115.64
4/3/2015 5:00	7.08	271.33		191.22	104.99	23.00	130.73
4/3/2015 6:00	7.08	202.33		202.90	90.09	32.51	136.45

Average Flow Pump Station 1 (MGD):	0.000
Average Flow Pump Station 9 (MGD):	0.315
Average Flow Pump Station 5 (MGD):	0.178
Average Flow Pump Station 6 (MGD):	0.033
Average Flow Pump Station 4 (MGD):	0.229
Average Flow Pump Station 3 (MGD):	0.400
Total GWI Flow (MGD):	1.155

refer to Pump Station 3 Flow Estimate Sheet



APPENDIX D: TOWN OF HULL SEWER CODE

Town of Hull Wastewater Treatment Plant

1111 Nantasket Avenue
Hull, MA 02045

Phone (781) 925-1207
Fax (781) 925-3771

Sump pump Inspection Protocol

When a sump pump inspection is needed for whatever reason, the following guidelines should be followed:

- Fill out a Town of Hull Inspection form
- Check the basement for the presence of a sump pump
- If a sump pump is present, follow the piping to determine the discharge location
- Note the location of the discharge pipe
- Check for floor drains, if present, determine the discharge point
- Check the building exterior for roof leaders / downspouts, determine and note the discharge point

If a sump pump, a roof leader or a floor drain is connected to the municipal sewer system, the property owner must have it redirected immediately to remove the flows from the sewer system.

§149-16. Prohibited Discharge to Sanitary Sewer.

Preamble: Whereas the unauthorized discharge of water into the sanitary sewer system of the town can result in the introduction into said system of harmful liquids and also results in an overcharging of the system which may lead to damage to the system, all of which may unnecessarily increase the cost of the operation, it is declared that the public health and safety warrant this bylaw regulating same.

A. No person (which shall also mean any entity or corporation) shall discharge or cause or permit to be discharged any stormwater, surface water, groundwater, roof runoff, subsurface drainage, uncontaminated cooling water or unpolluted industrial process waters or the like to any sanitary sewer by any subsurface drainage, downspout, eave trough, rainspout, yard drain, sump pump, foundation drain, yard fountain, pond, swimming pool, cistern overflow or air conditioning unit or system or similar device or means.

B. 1. Inspections. All inspections provided for in this section must be at times that are reasonably convenient for ordinary citizens. Town staff may apply to the District Court for an appropriate administrative search warrant if a property owner refuses to allow an inspection of the owner's property.

2. Regular inspections. Within 30 days after written notice from the town, every person owning improved real estate that discharges into the town's sanitary sewer system must allow the town or a designated town representative to inspect the buildings to determine whether there is a prohibited discharge into the sanitary sewer system. In lieu of having the town inspect the property, a person may furnish an inspection report in a form acceptable to the town from a licensed plumber approved by the town.

3. Re-inspections. A property that is found to be not in compliance with this section is also subject to reinspections to confirm that the property is subsequently brought into compliance. Thereafter, the property is subject to reinspections on an annual basis or when deemed necessary to confirm continued compliance. Properties that are in compliance may also be subject to reinspections to confirm continued compliance.

4. Inspections for building, health, fire or other permits or code compliance. If a town inspector is on property for the purpose of inspecting for compliance with a permit or for compliance with the law, the town inspector has the authority to also inspect the property for compliance with this section.

5. Inspection for property being sold or conveyed. Prior to the sale, transfer or conveyance of the ownership of a building serviced by a sanitary sewer, the owner, buyer or other appropriate party shall request an inspection and shall file prior to the sale, transfer or conveyance with the Permanent

Sewer Commission a certificate of compliance. Changing ownership without such a certificate is a violation of this section. In order not to delay or prevent a pending sale of a property affected by this section, a buyer, other transferee or other appropriate party may file with the Sewer Department evidence of a contract or accepted bid for work which, when completed, will bring the property into compliance with the provisions of this law within the time limits set forth by the Sewer Department, along with evidence that adequate funds have been or will be escrowed to complete said work, and a stipulation agreeing to bring the property into compliance with the provisions of this section. Failure by the buyer, transferee or other appropriate party to so bring the property into compliance shall constitute a violation of this bylaw and shall be subject to the penalties and remedies set forth herein.

C. Corrections. The owner of a property found to be in violation of this section must make the necessary corrections to comply with this section within the time specified in the written notification from the town.

D. Temporary waiver. The Chief Facility Manager (or designee) may allow or require a temporary waiver from the provisions of this section where a strict enforcement would cause a threat of damage to other property. A written request for a temporary waiver must be first submitted to the Chief Facility Manager specifying the reasons for the request. If a waiver is required or granted, the property owner must pay an additional fee for sanitary sewer services based on the number of gallons discharged into the sanitary sewer system as estimated by the Chief Facility Manager. The Chief Facility Manager may terminate the waiver upon a failure to comply with any conditions imposed in the temporary waiver or may take appropriate legal action to enforce those conditions. The Chief Facility Manager must give five days advance written notice of the termination to the property owner with the reasons for the action. After expiration of termination of a temporary waiver, the property owner must comply with the provisions of the section.

E. Violations. Any person, entity or corporation violating the provisions of this section shall be liable to a fine of not more than _____ for each violation. Each day on which any violation or offense exists shall constitute a separate violation or offense. Violations may also be processed under the non-criminal disposition procedure pursuant to Chapter 1 of the Code/Bylaws of the Town.

F. No warranty. A certificate of compliance or inspection done by the town indicates that so far as can be reasonably determined by a visual inspection of the premises and review of town records, the premises meet

the requirements of this article. Neither the town nor its inspectors assume any liability in the inspection or issuance of a certificate of compliance or inspections, and the issuance of a certificate of compliance or inspections does not guarantee or warrant the conditions of the premises inspected.

Nothing contained herein shall be construed to be a specific assurance of safety or assistance.

G. Remedies. The remedies provided in this section are cumulative and do not limit the right of the town to pursue any available legal remedy.

WOODARD &CURRAN

woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS